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The Utilization of Loose Parts Play Media in Early Childhood Pre-Mathematics Learning

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ABSTRACT

Loose parts media is a creative and effective learning media for early childhood, especially in supporting the development of pre-mathematics skills. This study aims to analyze the use of loose parts media in learning pramathematics through play. The research method used is descriptive qualitative through direct observation of 4-5 years old totaling 10 children, interviews with teachers and principals, and analysis of related documents in the form of teacher's daily journals. The results of this study show that loose parts media is effectively used to improve children's cognitive abilities in logical thinking in recognizing patterns, classifying objects, and understanding basic math concepts such as numbers and shapes. This activity also stimulates creativity, exploration and collaboration between children in a fun learning atmosphere. Based on these findings, it is recommended that educators use loose part game media in daily learning activities to enrich early childhood learning experiences, especially in the field of pre-math. This research can improve logical thinking skills by manipulating loose parts in solving problems, developing cognitive and analytical skills early on in teaching premathematics, and developing more varied teaching strategies in utilizing the use of loose parts media through games.

Kata kunci: *Game Media; Premathematics Learning; Loose parts; Early Childhood*

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INTRODUCTION

Logical-mathematical intelligence is a form of intelligence related to numbers and logic (Syarifah, 2019; Warmansyah et al., 2023). A child who possesses logical-mathematical intelligence generally demonstrates the ability to recognize time, understand cause-and-effect relationships, grasp counting concepts, observe objects, understand their functions, and solve problems requiring logical thinking (Hazizah, 2020). Mathematical ability is one of the essential skills that support the development of other aspects (Amalina, 2020; Amini et al., 2022; Yasin et al., 2020). Children acquire mathematical ability through various processes that can be applied in conceptual forms to solve problems. These skills include classifying, matching, sequencing, comparing, and counting (Zulminiati et al., 2023).

Parents often express concerns that some children are unable to follow lessons when entering elementary school, particularly mathematics learning (Anyelir et al., 2025; Sari et al.,

2023; Wulandani et al., 2022). This situation causes parents to worry about their children's future counting ability, a phenomenon known as math anxiety (Mutlu, 2019). In fact, mathematical ability serves as one of the key foundations that supports other developmental aspects and determines mathematical competence in higher educational stages. Therefore, the development of pre-mathematical abilities is necessary from an early age (Laily et al., 2019). Mathematical skills in early childhood are acquired through various processes that can be applied in conceptual forms to solve problems. This is reflected in the ability to classify, match, sequence, compare, and count (Zulminiati et al., 2023). Early childhood learners naturally gain experiences through concrete and tangible media that are familiar to them. They have a strong curiosity; therefore, an enjoyable and effective mathematics learning process through play can enhance their logical and mathematical abilities (Jutin & Maat, 2024).

Each child undergoes different cognitive developmental stages, which include their abilities in information processing, conceptual understanding, logical thinking, and problem-solving. Children develop the ability to process information from their environment as they grow and develop. They also learn to observe, identify, and remember information received through their senses such as processing information visually, auditorily, and through sensory experiences to understand their surroundings (Syafnita & Mukhlisin, 2019).

Moreover, between the ages of two and six, children are in a critical period where their cognitive abilities grow rapidly, surpassing later developmental stages. Therefore, early childhood education programs are essential, as children at this stage require creative, engaging, and supportive learning activities that cater to all types of learning styles (Wahjusaputri et al., 2024).

Some fundamental principles of play make early childhood learning meaningful. The principles are: play is learning, play is movement, and play shapes behavior. Through the principle of learning through play, children's play and exploration stimulate their cognitive development. The principle of play as movement encourages both gross and fine motor development from an early age. Additionally, the principle of play shaping behavior helps children build knowledge and develop positive habits through repetition and modeling (Haoyue & Marie Oyam, 2024). Learning through play is a joyful way for children to acquire new knowledge. What children play with becomes strongly imprinted in their memory during learning. During play, children make various choices, such as solving problems, thinking critically, communicating, negotiating, and discussing with peers (Syarfina & Warmansyah, 2025; Wita & Villanueva, 2025; Wulandari et al., 2025). Games that make children happy, excited, and engaged while learning include activities that use loose parts play media (Lily et al., 2023).

The Loose Parts Play Theory was introduced by architect Simon Nicholson in 1970. Nicholson argued that the loose elements in our environment can be used to empower creativity. To make children inventive and creative, adults must provide them with a variety of materials that can be moved, carried, combined, stacked, arranged, redesigned, taken apart, and reassembled without specific instructions or rules (Dhiaulhaq et al., 2024; Priyanti & Warmansyah, 2021; Utami et al., 2023). Loose parts are educational media used in early childhood institutions made of materials that can be moved, combined, and reused. Playing

with loose parts aims to stimulate children's creativity by allowing them to freely assemble and disassemble materials based on their imagination. This medium also teaches children to appreciate materials, interact with nature, and participate in environmental preservation through recycling activities (Lestariningrum & Wijaya, 2020). The use of loose parts in pre-mathematical learning has strong justification, as children more easily grasp abstract concepts when learning through play. One crucial stimulation provided by loose parts play is problem-solving and risk-taking, both of which are closely related to scientific thinking (Kasih et al., 2023). Loose parts media also enhance children's skills and socialization, encouraging communication and negotiation. This affordable and adaptable learning approach inspires creativity and increases engagement in learning experiences (Pramitasari & Nurfitriah, 2024).

Although numerous studies have highlighted the role of play in early childhood cognitive development, few have specifically focused on the structured application of loose parts play media in supporting early mathematical understanding. Previous studies have predominantly examined general play-based learning or sensory play without addressing how manipulatives such as loose parts can systematically build foundational mathematical concepts such as classification, patterning, and quantification (Annet, 2020). This lack of empirical focus on pre-mathematical dimensions creates a significant gap in current early childhood pedagogical research.

Furthermore, current educational practices in many early childhood institutions tend to rely heavily on worksheet-based or teacher-directed activities, which limit children's opportunities to explore open-ended materials (Pratiwi et al., 2024). This contradicts the principles of developmentally appropriate practice that emphasize exploration, autonomy, and experiential learning. Integrating loose parts play media offers an alternative pedagogical approach that bridges this gap by transforming abstract mathematical concepts into tangible and experiential learning opportunities (Patimah & Nurhayati, 2023).

Recent studies emphasize the growing importance of sustainability and creativity in early childhood education, advocating the use of recycled or natural materials to stimulate problem-solving and innovative thinking (Greenfield et al., 2024). Loose parts play aligns with this global movement by combining environmental consciousness with cognitive stimulation. Through spontaneous manipulation and experimentation, children engage in the early foundations of mathematics such as counting, ordering, measuring, and comparing within meaningful play contexts.

Building on these findings, the present study explores the utilization of loose parts play media in early childhood pre-mathematics learning. The study aims to investigate how this media can stimulate logical–mathematical thinking, foster creativity, and promote problem-solving skills among young learners. Specifically, it seeks to examine how the manipulation of loose materials supports pre-mathematical abilities such as classification, comparison, sequencing, and counting in early learning settings.

RESEARCH METHODOLOGY

Research Design

This study employed a descriptive qualitative method, focusing on the implementation of pre-mathematics learning activities that integrated the theme My Nature

(Alamku) and the sub-theme Natural Objects (Benda-Benda Alam). The research was conducted at PAUD Islam Cikal Harapan 2 BSD, involving a total of 10 children aged 4–5 years.

The distinctive feature of qualitative research lies in data collection through direct observation and open-ended interviews with participants. Researchers act as the main instruments of inquiry, using tools such as interview guides, observation sheets, and reflective journals. After collecting qualitative data, the researcher conducted a thematic analysis and presented the findings in descriptive form, supported by narrative and visual documentation (Weyant, 2022).

The learning process was organized into a sequence of pre-mathematical activities designed to stimulate children's early numeracy, classification, and problem-solving abilities through loose parts play. The research procedure followed the stages of observation, implementation, reflection, and evaluation to determine improvements in children's pre-mathematical skills. An illustration of the research design and learning sequence is presented below:

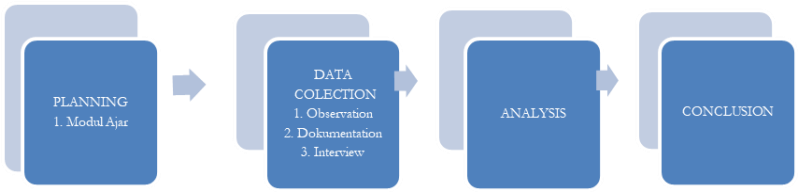

Figure 1. Stages of Learning Design in the Utilization of Loose Parts Play Media for Pre-Mathematics Learning in Early Childhood.

Participants and Setting

The participants consisted of 10 children aged 4–5 years, enrolled in the Preparation Center (Sentra Persiapan) at PAUD Islam Cikal Harapan 2 BSD. The selection of participants was based on their active involvement in pre-mathematics learning sessions using loose parts materials. In addition to the children, the headmaster and the lead teacher served as key informants who provided insight into the learning implementation and the observed improvements in children's pre-mathematical abilities.

The study setting was characterized by a child-centered learning environment that encouraged hands-on exploration through natural and recycled materials. This approach allowed children to manipulate, classify, and organize objects as part of the mathematical learning process.

Data Collection Techniques

Data were collected through multiple qualitative techniques: observation, interviews, documentation (photo and video records), and teacher reflective journals. **Observation:** Conducted directly during learning sessions to record children's activities, engagement, and behaviors related to early mathematical concepts. **Interviews:** Semi-structured interviews were conducted with the headmaster and classroom teacher to gather insights into instructional implementation and the observed development of children's mathematical

reasoning. **Documentation:** Visual records (photos and videos) were used to capture learning moments and children's interactions with loose parts materials. **Teacher's Reflective Journal:** Served as supplementary data describing the teacher's reflection on each learning cycle, particularly regarding challenges, observed progress, and strategies for improvement. All data sources were triangulated to ensure credibility and reliability. Observational findings were used not only to identify developmental progress but also as the basis for revising and refining learning plans for subsequent sessions.

Research Instruments

The main instrument in this study was the researcher, supported by auxiliary tools such as observation checklists, interview guides, field notes, photo and video documentation templates, and teacher reflective journal sheets. Each instrument was designed to capture both the process and the outcomes of children's engagement with loose parts play during pre-mathematics learning sessions.

Data Analysis Procedure

Data analysis in qualitative research is a process of organizing, interpreting, and deriving meaning from collected data to draw relevant conclusions. It involves systematically sorting, categorizing, and synthesizing information into coherent patterns (Qomaruddin & Sa'diyah, 2024). The data analysis in this study followed three main stages:

Data Reduction

In this phase, the researcher filtered and selected relevant data from observations, interviews, and journals. The focus was placed on children's activities in recognizing numbers, identifying geometric shapes, classifying objects, and demonstrating logical reasoning during play.

Data Display

The reduced data were then presented in the form of descriptive narratives and visual documentation, including photographs and observation tables. The data were organized into matrices that reflected key pre-mathematical indicators such as object classification, number recognition, geometric construction, and creativity in manipulating materials.

Conclusion Drawing and Verification

Conclusions were drawn based on recurring patterns and consistent findings across data sources. The analysis revealed that the utilization of loose parts play media encouraged children to be more active, creative, and logical in completing pre-mathematical activities. The researcher continuously verified conclusions through member checking and triangulation to maintain validity and trustworthiness.

Trustworthiness of the Data

To ensure the trustworthiness of the findings, the study employed triangulation of data sources and methods, prolonged engagement during classroom observations, and peer

debriefing with teachers. The use of multiple instruments and reflection journals also strengthened the credibility and transferability of the results.

RESULTS AND DISCUSSION

Essentially, early childhood learners love to play and learn through concrete objects. Therefore, learning using loose parts media at PAUD Islam Cikal Harapan 2 BSD has implemented effective and engaging learning while providing various types of activities. The purpose of the loose parts media used is to introduce pre-mathematical concepts such as numbers, basic critical thinking skills, curiosity, number recognition, size, and shape.

During the research, the children looked very enthusiastic when the teacher from the preparation center took them around the school environment, with the aim that the children would directly recognize natural objects that can be used as learning media while playing. Outdoor activities are often interesting and challenging for students because they can increase their intrinsic motivation toward learning. Students will directly observe natural phenomena, be able to explore and experiment, and collect information outside the classroom (Maulani et al., 2023).

Children prefer to express their desires by increasing their curiosity to explore their cognitive abilities. They explored together to find natural objects that would be used as learning media. In addition, this loose parts media also provides freedom for children to think critically in solving simple problems and to express their creative ideas through play.

Moreover, the use of loose parts media obtained from the surrounding environment is also able to develop skills in designing varied activities. Therefore, in pre-mathematics learning for early childhood with the theme My Nature (Alamku), these media easily found materials such as dry leaves, pebbles, twigs, and others give an enjoyable learning experience while enriching children's exploration of basic pre-mathematical concepts.

Through this learning process, children are encouraged to think creatively and logically and to be able to connect objects found in their surroundings such as pebbles, coral stones, dry leaves, tree branches, seeds, bottle caps, and buttons with pre-mathematical concepts in counting, recognizing basic geometric shapes, and measurement. In addition, the use of loose parts media also encourages children to be more active in the learning process, enhances problem-solving skills, and builds curiosity about nature. Thus, learning becomes more meaningful because it involves direct experiences relevant to everyday life.

Figure 2. Loose Parts Media

In pre-mathematics learning shown in Figure 2, students classified stones based on size and color. The students were able to compare the sizes of the stones, then group them

according to large and small sizes in the containers provided, and classify the pebbles based on color.

Figure 3. Classification Learning Based on Size and Color

Classification is the process of grouping objects or information based on certain characteristics. In the context of early childhood, classification can be done based on size (large and small) and also color. This helps children understand basic concepts of category and difference. The teacher stated that during the classification activity by color and size, the students carefully observed and compared the sizes of one stone with another. This shows the children's critical and logical thinking abilities in comparing problems and sizes. They have great curiosity, which enables them to demonstrate developing logical and mathematical abilities (Lehwald, 1991). The third learning activity conducted was forming geometric shapes using loose parts media. In this activity, students were given pre-mathematical knowledge about geometric shapes, and then they created these shapes as shown in Figure 3. This learning helped the students to recognize basic geometric shapes, train analytical skills, and enhance creativity in designing shapes. The first stage in recognizing geometric shapes is that children learn to recognize simple shapes (triangle, circle, square). Then, the child learns about the characteristics of each geometric shape and applies that knowledge to create constructions using geometric forms" (Afni et al., 2021).

Figure 4. Learning to Recognize and Create Geometric Shapes Using Stones

Introducing children to basic geometric shapes is very important to teach from an early age because it is part of shape recognition learning within pre-mathematical concepts. This is one of the early concepts that children must master in cognitive development so that they can distinguish objects based on shape before considering other characteristics. The goal of introducing geometry is for children to be able to recognize and name various kinds of objects based on geometric shapes by observing objects around them (Mappapoleonro et al., 2024).

Figure 5. Learning Number Symbols

Pre-mathematical learning for early childhood in Figure 5 aims to introduce basic pre-mathematical concepts before children formally learn them. One effective and interesting activity to introduce number symbols 1–5 is by tracing number symbols on sand. Sand media is a learning aid that is very beneficial in developing children's sensory and fine motor skills, which are part of natural loose parts media.

By using sand, children not only practice fine motor skills but also feel a different texture, helping them become physically connected to the learning activity. Tracing number symbols on sand provides a deep tactile experience, making it easier for children to remember the shape of the numbers. By combining visual and tactile aspects, children learn to recognize number shapes in a more holistic way, enhancing creativity and curiosity, which allows them to continue experimenting or making mistakes without fear. They can easily erase and retrace the numbers if they make a mistake or wish to try again.

Figure 6. Learning to Sequence Number Symbols 1–5

In Figure 6 above, children engage in activities of counting and sequencing number symbols 1–5. Learning to recognize number order by arranging number cards 1–5 is an effective method for early childhood to understand number order and number recognition. In this activity, children were asked to pick number cards from 1 to 5 sequentially and then place an equivalent number of loose parts materials such as coral stones corresponding to the number shown on the card.

This learning helped them remember and understand that numbers have a fixed sequence and sharpened cognitive abilities in recognizing and distinguishing numbers. The activity aims to build an early foundation for understanding number concepts and mathematics as a whole. One beneficial pre-mathematical activity is sequencing numbers 1–5 to help children gradually understand number order. Through sequencing number cards, children not only learn to recognize the shape of numbers but also train fine motor skills and strengthen logical thinking, pattern recognition, memory, and early counting abilities. They develop these characteristics starting from their immediate environment, progressing toward understanding quantities related to addition and subtraction (Novianti, 2015).

Figure 7. Learning the Concept of Numbers 1–5

Learning to recognize number symbols in Figure 7 involves introducing number concepts 1–5 creatively using stones (loose parts) as learning media. Through this activity, children were invited to use coral stones labeled with numbers or left plain to help them count and recognize number symbols. Children could arrange these stones from numbers 1 to 5 while naming the numbers.

Mathematical skills taught to preschool children not only focus on learning about numbers and number systems but also emphasize understanding number concepts starting from matching, comparing, grouping, and creating patterns or recognizing shapes found in daily life (Trisna et al., 2023). This learning also helps children connect number concepts with real objects so that they can understand that each number represents a specific quantity. Through this activity, children develop cognitive and fine motor skills while moving and arranging stones in the correct order. Additionally, learning with stones provides a rich sensory experience that helps reinforce children's understanding of numbers and numerical concepts.

Figure 8. Classification Learning by Large and Small Sizes

Classification learning by large and small sizes used dry leaves as natural media. Arranging, selecting, collecting, or separating a set of objects into smaller groups based on their characteristics (size, color, shape) is called classification (Lasuka et al., 2019). In this learning, the children were invited to walk around the school environment at PAUD Islam Cikal Harapan 2 BSD to collect and observe leaves of various types and sizes. Then, they were asked to classify the dry leaves based on size from the largest to the smallest or vice versa.

This learning helped children recognize concepts of comparison and classification, which are the foundation of mathematical and logical thinking skills. Children learned to pay attention to details, sharpen observation skills, and develop fine motor abilities while arranging and grouping the leaves(Ramadhani et al., 2022). In addition, by using natural elements such as dry leaves, learning became more engaging and enjoyable, fostering a sense of love for the natural environment. Classification learning can be conducted indoors or

outdoors using media available in the classroom to increase knowledge and experience through exploration and interaction with nature and the surrounding environment.

Based on the results of teacher daily assessment instruments, notes showed that the ability to create and design geometric shapes using loose parts media indicated that about 10% of the children were still at the Beginning to Develop (MB) indicator, meaning that the geometric shapes created with loose parts were not yet consistent with the geometric shapes instructed by the teacher. This occurred because fine and gross motor skills, as well as shape recognition, are still developing at the early childhood stage. This served as a reminder for the teacher to further enhance children's critical thinking and motor skills in designing shapes using coral stone media.

However, 50% of the children were already in the Developing as Expected (BSH) category and were able to construct geometric shapes according to the teacher's instructions, differentiate geometric shapes, and understand their names, such as circles, triangles, squares, and rectangles.

Pre-mathematics learning using loose parts play media was highly favored by students, teachers, and parents alike not only because the materials are easily obtained but also because loose parts media offer many advantages in supporting pre-mathematics learning. According to theacher students enjoyed this learning model because it allowed them to learn mathematics joyfully through the learning by playing concept, reducing their anxiety toward mathematics, which is often perceived as difficult.

The utilization of loose parts media in pre-mathematics learning not only supports children's cognitive development but also strengthens social-emotional and creative aspects. This provides a significant foundation for teachers, policymakers, and educational institutions to develop loose parts-based learning approaches within early childhood learning environments.

CONCLUSION

The study concludes that the utilization of loose parts play media in pre-mathematics learning at PAUD Islam Cikal Harapan 2 BSD is highly effective in enhancing early childhood pre-mathematical skills through exploratory and play-based activities. By engaging with natural and recycled materials such as stones, bottle caps, buttons, and twigs, children learn to count, recognize geometric shapes, and understand measurement in a concrete, enjoyable, and meaningful way. This hands-on, creative, and experiential approach not only strengthens conceptual understanding but also fosters critical thinking, collaboration, and creativity forming a holistic foundation for future mathematical learning and lifelong cognitive development.

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